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ATTORNEY DOCKET NO. 10030753-01

*Handwritten initials: JF*

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Laura Wills Mirkarimi

Serial No.: 10/765647

Examiner: Duy Vu Nguyen Deo

Filing Date: January 26, 2004

Group Art Unit: 1765

Title: Method For Etching High Aspect Ratio Features In III-V Based Compounds For Optoelectronic Devices

COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria VA 22313-1450

TRANSMITTAL OF APPEAL BRIEF

Sir:

Transmitted herewith is the Appeal Brief in this application with respect to the Notice of Appeal filed on June 14, 2006.

The fee for filing this Appeal Brief is (37 CFR 1.17(c)) **\$500.00**.

(complete (a) or (b) as applicable)

The proceedings herein are for a patent application and the provisions of 37 CFR 1.136(a) apply.

☐ (a) Applicant petitions for an extension of time under 37 CFR 1.136 (fees: 37 CFR 1.17(a)(1)-(5)) for the total number of months checked below:

<input type="checkbox"/>	one month	\$ 120.00
<input type="checkbox"/>	two months	\$ 450.00
<input type="checkbox"/>	three months	\$1020.00
<input type="checkbox"/>	four months	\$1590.00

☐ The extension fee has already been filled in this application.

☒ (b) Applicant believes that no extension of term is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition and fee for extension of time.

Please charge to Deposit Account **50-1078** the sum of **\$500.00**. At any time during the pendency of this application, please charge any fees required or credit any overpayment to Deposit Account **50-1078** pursuant to 37 CFR 1.25.

A duplicate copy of this transmittal letter is enclosed.

☒ I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Date of Deposit: August 7, 2006 OR

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Date of Facsimile:

Typed Name: Nelia T. de Guzman

Signature: Nelia T. de Guzman

Respectfully submitted,

Laura Wills Mirkarimi

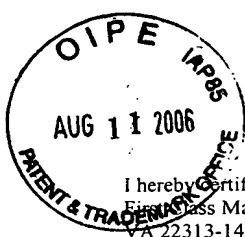
By

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Reg. No. 41,127

Date: August 7, 2006

Telephone No. 408 553-2804



I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to the Commissioner for Patents, P. O. Box 1450, Alexandria, VA 22313-1450 on August 7, 2006.

By Nelia T. de Guzman  
Nelia T. de Guzman

Date August 7, 2006

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Inventor(s): Laura Wills Mirkarimi Confirmation No.: 1183  
Application No.: 10/765,647 Examiner: Duy Vu Nguyen Deo  
Filed: January 26, 2004 Group Art Unit: 1765  
Title: METHOD FOR ETCHING HIGH ASPECT RATIO FEATURES IN  
III-V BASED COMPOUNDS FOR OPTOELECTRONIC DEVICES

Attorney Docket No.: 10030753-1

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

BRIEF ON APPEAL

Sir:

This brief is in furtherance of Applicant's Notice of Appeal filed June 14, 2006 appealing the decision of the Examiner dated March 14, 2006 finally rejecting Claims 1-20. A copy of the Claims appears in the Appendix to this Brief. This Brief is transmitted in triplicate.

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REAL PARTY IN INTEREST

The real party in interest in this appeal is: Agilent Technologies, Inc.

## RELATED APPEALS AND INTERFERENCES

With respect to other appeals or interferences that will directly affect, or be directly affected by, or have bearing on the Board's decision in the pending appeal, there are no such appeals or interferences.

## STATUS OF CLAIMS

### A. TOTAL NUMBER OF CLAIMS IN THE APPLICATION

Claims in the Application are 1-20.

### B. STATUS OF ALL CLAIMS IN APPLICATION

1. Claims cancelled: NONE
2. Claims withdrawn from consideration but not cancelled: NONE
3. Claims pending: 1-20
4. Claims allowed: NONE
5. Claims rejected 1-20

### C. CLAIMS ON APPEAL

The Claims on Appeal are: 1-20.

## STATUS OF AMENDMENTS

A Response to the Final Office Action was filed April 14, 2006 including a Terminal Disclaimer; however, no Amendments were made to the Claims. An Advisory Action before Filing of an Appeal Brief was issued April 24, 2006. Therefore, the Claims on appeal herein are Claims 1-20 as finally rejected in the Final Office Action dated March 14, 2006.

## SUMMARY OF CLAIMED SUBJECT MATTER

The claimed invention is directed to a method for combining Reactive Ion Etching (RIE) with bromine based chemistry to etch III-V based compounds such as InP. Mixtures of HBr with CH<sub>4</sub> and H<sub>2</sub> provide fast etch rates, vertical sidewalls and good control over the growth of polymers that arise from the presence of CH<sub>4</sub> in the mixture. In accordance with the invention, HI or IBr or some combination of group VII gaseous species (Br, F, I) may be substituted for HBr. Typical values in accordance with the invention for mixtures of HBr, CH<sub>4</sub> and H<sub>2</sub> are HBr in the range of about 2 to 75 percent, CH<sub>4</sub> in the range of about 5 to 50 percent and H<sub>2</sub> in the range of about 5 to 40 percent by volume at pressures in the range from about 1 to 30 mTorr.

A method for etching high aspect ratio features in III-V based compounds for optoelectronic devices in accordance with the invention is described starting on page 3, line 1 of the specification, shown in FIGs. 1a-c. The method as recited in Claim 1 for etching a III-V semiconductor material (110) comprises placing a semiconductor substrate (105) on which the III-V semiconductor material (110) has been deposited into a reactive ion etching reactor (205); introducing a first gas chosen from HBr, HI and IBr into the reactive ion etching reactor (205), introducing a second gas of CH<sub>4</sub> into the reactive ion etching reactor (205), introducing a third gas of H<sub>2</sub> and exposing a portion of the III-V semiconductor material (110) to be etched to a mixture comprising the first, the second and the third gas.

## GROUND OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1-20 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Fathimulla et al. (U.S. Patent No. 5,338,394) and Pearton et al. (Applied Physics Letters 60 (7)).



## ARGUMENT

### GROUND OF REJECTION (Claims 1-20)

The Examiner has finally rejected Claims 1-20 under 35 U.S.C. 103(a) as being unpatentable over Fathimulla et al. (U.S. Patent No. 5,338,394) in view of Pearton et al. (Applied Physics Letters 60 (7)).

Regarding Claims 1-20, the Examiner states in part that:

Fathimulla describes a method for etching an III-V material comprising: placing the III-V substrate into a RIE chamber and etching the substrate with a gas mixture of HBr and CH<sub>4</sub> (claims 1-4). Unlike claimed invention, Fathimulla doesn't describe the gas mixture having H<sub>2</sub>. Pearton teaches a method for etching III-V material wherein the gas mixture includes H<sub>2</sub> (pages 839; left column). It would have been obvious for one skilled in the art at the time of the invention to modify Fathimulla in light of Pearton by including H<sub>2</sub> in the gas mixture because Pearton teaches addition of the H<sub>2</sub> to the gas mixture provide a much smoother surfaces and Fathimulla teaches that other combinations of gas composition can be used to give a smooth vertical feature (col. 3, line 65-68).

The Examiner cites *In Re Keller*, 642, F.2d 413 for the proposition that one cannot show nonobviousness by attacking the references individually where rejections are based on combinations of references. The Examiner has apparently failed to understand the Applicant's argument. The Applicant's argument is that Examiner has failed to make a *prima facie* case of obviousness and has therefore failed to meet his burden. To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in the applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Fathimulla et al. discloses using HBr and CH<sub>4</sub> or HBr and H<sub>2</sub> together (see col. 2, lines 14-18) but not HBr, CH<sub>4</sub> and H<sub>2</sub> together as recited in Claims 1 and 12. Fathimulla et al. does not disclose the use of HI. Furthermore, there is a teaching away by Fathimulla et al. of using both CH<sub>4</sub> and H<sub>2</sub> in the same mixture for smooth surfaces as these gases are always recited by Fathimulla in the alternative, e.g.: “H<sub>2</sub> or CH<sub>4</sub> is introduced into the ECR region” (emphasis added) (see col. 2, lines 56-57) and “[s]mooth surfaces can be produced by reactive ion etching using a mixture of SiCl<sub>4</sub>, and H<sub>2</sub> or CH<sub>4</sub>”. (emphasis added) (col. 3, lines 59-61). This would not motivate one skilled in the art to use both H<sub>2</sub> and CH<sub>4</sub> together with HBr as recited in Claims 1 and 12 because Fathimulla et al. discloses using H<sub>2</sub> and CH<sub>4</sub> in the alternative. Hence, Fathimulla et al. teaches away from the claimed combination.

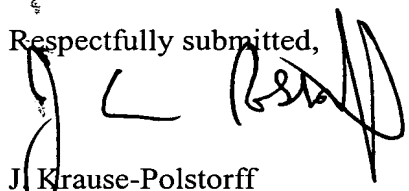
Pearton et al. teaches replacing a CH<sub>4</sub>, H<sub>2</sub> and Ar mixture with a HI, H<sub>2</sub> and Ar mixture (e.g., see bottom of col.2, p. 838 and first full paragraph, col. 2, p. 840). This is a teaching of replacing CH<sub>4</sub> by HI and is a teaching away from the use of CH<sub>4</sub> and H<sub>2</sub> together with HI. Thus, Pearton also teaches away from using CH<sub>4</sub> and H<sub>2</sub> together with HI as recited in Claims 1 and 12. Hence, there is nothing to motivate one skilled in the art to combine the two references and modify Fathimulla et al. in view of Pearton et al. to use both H<sub>2</sub> and CH<sub>4</sub> together with HI as both references in combination teach away from using use both H<sub>2</sub> and CH<sub>4</sub> together with HI as recited in Claims 1 and 12. The Examiner has failed to provide a motivation to combine the reference teachings and further the combination of the references does not teach, suggest or disclose all the Claim limitations of Claims 1 and 12. Therefore, neither Fathimulla et al. nor Pearton et al. either singly or in combination disclose, teach or suggest using HI, CH<sub>4</sub> and H<sub>2</sub> together as recited in Claims 1 and 12. Hence, the Examiner has failed to make a prima facie case of obviousness because there is no motivation to combine the two references to achieve the instant invention as both Fathimulla et al. and Pearton et al. teach away from using CH<sub>4</sub> and H<sub>2</sub> together. Further, the teaching away by both

Fathimulla et al. and Pearton et al. of using CH<sub>4</sub> and H<sub>2</sub> together is an important indicium of nonobviousness (see *U.S. v. Adams*, 383 U.S. 39 (1966) and *In re Hedges*, 783 2d 1038, 226 USPQ 685 (Fed. Cir. 1986).

Hence, Claims 1 and 12 are allowable over Fathimulla et al. in view of Pearton et al. Claims 2-11 and Claims 13-20 depend from Claims 1 and 12, respectively, and are allowable for at least the same reasons as Claims 1 and 12.

Therefore, Claims 1-20 are allowable and it is respectfully requested that the Board of Patent Appeals and Interferences reverse the Examiner's final rejection of Claims 1-20 so that this case may be allowed and pass to issue in a timely manner.

Respectfully submitted,

  
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## CLAIMS APPENDIX

1. A method for etching a III-V semiconductor material comprising:  
placing a semiconductor substrate on which said III-V semiconductor material has been deposited into a reactive ion etching reactor;  
introducing a first gas chosen from HBr, HI and IBr into said reactive ion etching reactor;  
introducing a second gas of CH<sub>4</sub> into said reactive ion etching reactor;  
introducing a third gas of H<sub>2</sub>; and  
exposing a portion of said III-V semiconductor material to be etched to a mixture comprising said first, said second and said third gas.

2. The method of Claim 1 further comprising the etching of vertical features into said III-V semiconductor material.

3. The method of Claim 1 wherein the percentage of said first gas is in the range from about 2 to 75 percent by volume.

4. The method of Claim 1 wherein the percentage of said second gas is in the range from about 5 to 50 percent by volume.

5. The method of Claim 1 wherein the percentage of said third gas is in the range from about 5 to 40 percent by volume.

6. The method of Claim 1 wherein said reactive ion etching reactor is maintained at a pressure in the range from about 1 to 30 mTorr.

7. The method of Claim 1 wherein the DC bias for said reactive ion etching reactor is in the range from about 100 to 500 volts.

8. The method of Claim 2 wherein said vertical features have an aspect ratio greater than ten.

9. The method of Claim 1 further comprising the step of growing a mask onto said III-V semiconductor material.

10. The method of Claim 9 wherein said mask comprises silicon.

11. The method of Claim 10 wherein said mask is made of  $\text{Si}_3\text{N}_4$ .

12. A method for etching a III-V semiconductor substrate comprising:  
placing said semiconductor substrate into a reactive ion etching reactor;  
introducing a first gas chosen from HBr, HI and IBr into said reactive ion etching reactor;  
introducing a second gas of  $\text{CH}_4$  into said reactive ion etching reactor;  
introducing a third gas of  $\text{H}_2$ ; and  
exposing a portion of said III-V semiconductor substrate to be etched to a mixture comprising said first, said second and said third gas.

13. The method of Claim 12 further comprising the step of etching vertical features into said III-V semiconductor material.

14. The method of Claim 12 wherein the percentage of said first gas is in the range from about 2 to 75 percent by volume.

15. The method of Claim 12 wherein the percentage of said second gas is in the range from about 5 to 50 percent by volume.

16. The method of Claim 12 wherein the percentage of said third gas is in the range from about 5 to 40 percent by volume.

17. The method of Claim 12 wherein said reactive ion etching reactor is maintained at a pressure in the range from about 1 to 30 mTorr.

18. The method of Claim 12 wherein the DC bias for said reactive ion etching reactor is in the range from about 100 to 500 volts.

19. The method of Claim 13 wherein said vertical features have an aspect ratio greater than ten.

20. The method of Claim 12 further comprising the step of growing a mask onto said III-V semiconductor substrate.

## EVIDENCE APPENDIX

None.

## RELATED PROCEEDINGS APPENDIX

None.